Issues with Nexant Phase 2 Submetering Pilot Report re: Submeter Accuracy Testing
eMotorWerks + ChargePoint
November 30, 2018

I. Nexant / MET failed to provide lab or field test plans in advance

a. Pilot administrators did not share lab or field test set-up with MDMAs prior to accuracy testing, even though pilot materials had indicated delivery in April 2017.

   i. Table 3.2 in the report states that "MDMAs will propose methodologies for [field] testing and calibration for IOU review, consent, and implementation." This did not happen during the pilot. If it happened during the WG, it was not adhered to, as described in Section II below.

b. Tests were ran three months after the pilot concluded, and Nexant / MET changed their originally-determined test plan due to scheduling constraints.

II. Lab and field test set-ups were non-compliant with NIST Handbook 44, and MET demonstrates flawed reasoning in attempting to excuse the matter.

a. EVSE energy calibration conforming to NIST Handbook 44 is based on energy delivered at the **output** coupler at the end of the output cable. This calibration set-up measures the energy that is actually delivered to the car.

   In Nexant / MET lab and field testing, consumption was instead measured **upstream** of the EVSE, with measured power going through an unknown length of wiring to the EVSE, through a 40A breaker, then through the EVSE and output cable.

b. MET displays a lack of understanding of basic electricity in their response to our critique of their metering placement. In the diagram and passage below, MET claims there would be a small difference in measured energy if the radian meter measured current on the right side leg of the AC circuit instead of the the left side leg downstream of the EVSE due to IR losses in the cabling. This is wrong: the voltage measurement is from line-to-line and does not depend on which leg the current is measured on. , Note that the current on the right side is exactly the same as the left, as current is not consumed due to IR losses. Also, note that MET refers to about 1 mOhm resistance due to the Radian meter itself, which at 32 Amps line current would add a 1 Watt power error to the measurement. The Radian meter probably uses a shunt to measure current (as would be needed if that meter is also used for DC current measurements. AC energy metering in most or all EVSEs measure current with current transformers, which add no resistance or losses in the system. See blue highlighted section below.

c. Accuracy tests were ran for unrealistic charging scenarios—e.g., 1% of maximum load, 50% power factor[1]—and these results were subsequently given equal weight in the overall test scoring.

III. The lab's process of obtaining submeter readings introduces a potential source of error

a. Section 4.3 describes the lab's process of obtaining submeter kWh readings as "retrieving the charging consumption data via the MDMAs' smart phone app, which required the data to be transmitted to the cloud server and presumably included some form of data processing prior to being transmitted from the cloud back to the app." The

[1] EVSEs technically aren't operational at 1% of maximum load, and typically operate at well over 90% power factor.

report continues, “Without a direct diagnostic output from the charging station, it’s impossible to determine with complete certainty if the accuracy issues are from the submeter, data processing in the cloud, or both.”

This approach essentially invalidates any accuracy testing by the laboratory considering the sensitivity of a 1% threshold when considering decimalization and human-estimated time stamping. This is not how MDMAs pull data for interval data transfer. According to ChargePoint, “we take metering data from the accumulator registers on the Linux system that runs the charging station – you can’t get much closer to bare metal than that.”

IV. The report’s field testing accuracy characterizations are not appropriate

a. **Conflates Wi-Fi reliability with 2% metering accuracy.** In Section 4.3, Nexant inappropriately points to the potential intermittency of customer Wi-Fi as a possible source of data inaccuracy. Loss of connectivity resulting in zero or null values sent to the utility is not the same as meeting or failing to meet +/- 2% metering accuracy.
b. Similar to the lab test set-up, field testing loggers and metering procedures did not align with NIST HB44. Loggers measured consumption upstream of the EVSE instead of at the output coupler. The report notes that the largest source of inaccuracy was higher logger readings than submeter readings, which would be exacerbated by the field testing metering point. (see II.a)
c. If the +/- 2% accuracy target was to incorporate more than device metering accuracy and include end-to-end data integrity, then the solution would have needed to be architected differently. This was not outlined as an explicit obligation in the pilot.

V. Both ChargePoint and eMotorWerks submitted assertations ahead of the pilot demonstrating that our products test within the Acceptance Tolerance range of ± 1.0% specified in NIST Handbook 44. NIST HB44 is the industry standard in submetering accuracy.

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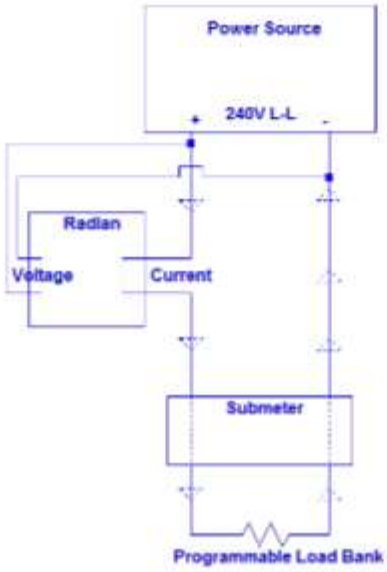
Figure 1: Updated Laboratory Test Setup Diagram



In the schematic above, current flows through the circuit at a potential of 240V. The Radian (load recording device) was measuring power upstream from the submeter, i.e. it was measuring power delivered directly from the power source. There would be almost no difference if the Radian was connected to the other branch (right side) of the circuit; any reduction in power recorded by the radian if located in the right side of the circuit would be related to very small I^2R losses in the additional length of cabling to and from the radian to the programmable load bank and connections to the load bank. The difference in power recorded in the radian was located on the right side of the drawing would be losses in heavy gauge cabling and connections at the load bank which are extremely low. The losses through the Radian (< 1mOhm) and the cables